



Analysis of a Novel Sensory Mechanism in Root Phototropism (Tropi)

Brief Summary

Plants sprouted from seeds will be video taped and samples collected will be analyzed at a molecular level to determine what genes are responsible for successful plant growth in microgravity. Insights gained from Tropi can lead to sustainable agriculture for future long duration space missions.

Principal Investigator

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Expeditions Assigned

While Tropi is a new experiment, other studies of plant growth and development have been conducted on ISS. The Advanced Astroculture™ (ADVASC) payload facilitated three experiments during ISS Increments 2, 4, and 5.

Research Summary

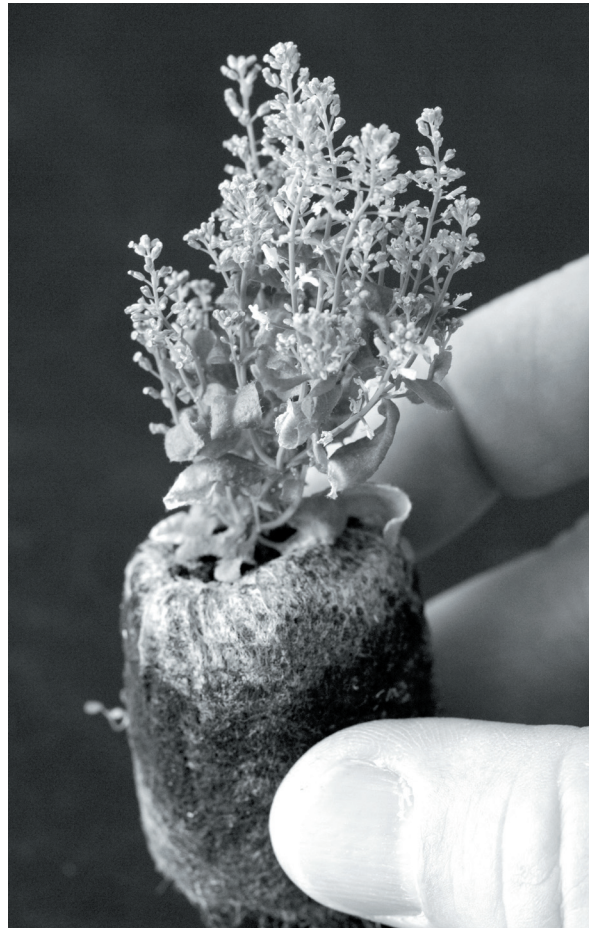
Tropi is a plant growth experiment that will investigate how plant roots respond to varying levels of both light and gravity (using a rotating centrifuge).

This experiment will help gain insight into how plants grow in space to help create sustainable life support systems for long-term space travel.

Plant growth under various gravity conditions (0G to 1.0G) is achieved using a rotating centrifuge.

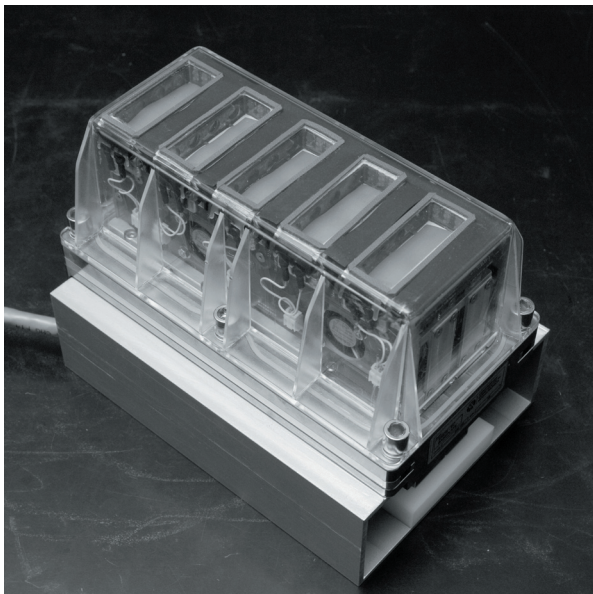
Description

Tropi consists of dry *Arabidopsis thaliana* (thale cress) seeds stored in small seed cassettes. *Arabidopsis thaliana* is a rapidly growing, flowering plant in the mustard family. The seed cassettes will be flown inside the European Modular Cultivation System (non-NASA link) (EMCS). The seeds will remain dry and at ambient temperature until hydrated by an automated system of the EMCS. At specified times during



Dwarf *Arabidopsis* plant.

the experiment, the plants will be stimulated by different light spectrums and by different gravity gradients. The only work required by the crew is to replace video tapes and harvest the plants when they are grown. Once the plants are harvested they will be stored in the Minus Eighty Degree Laboratory Freezer for ISS Minus Eighty Degree Laboratory Freezer for ISS (MELFI) until their return to Earth. Part of the experiment relies on a biochemical analysis of the returned plants, but the investigators will gather a large amount of data from video taped images of the plants, watching their roots as they develop in the EMCS.



European Modular Cultivation System experiment container with Tropi experiment unique equipment.

The EMCS is an experiment facility for biological investigations under microgravity. It shall allow for cultivation, stimulation and crew assisted operation of biological experiments under well controlled conditions. Depending on the experiment specific hardware, it can be adapted to different applications e.g. to (larger) plants, invertebrates and in potential future configurations also for confocal microscopic observations or for aquatic species. EMCS is designed as a payload for the EXPRESS rack. It will be launched inside an EXPRESS transportation rack on a utilization flight. The EMCS facility will be transported to the dedicated EXPRESS rack in the US Lab on ISS. The resupply modules for gas and water will be exchanged in intervals of three months to one year. The EMCS experiments are composed Experiment Containers (EC) and Experiment Unique Equipment (EUE) which are inside the EC. The EC's are loaded manually by crew in the facility. Once the loading by the crew is completed, the experiments will be performed automatically inside the EMCS.

Applications

Space Applications

During long-term space exploration it will be necessary to provide astronauts with regenerative sources of food as well as supplemental methods to recycle carbon

dioxide into breathable oxygen. As new information about how plants grow in microgravity emerges, sustainable plant-based life support systems may be developed.

Earth Applications

Further understanding of how plants grow and develop at a molecular level can lead to significant advancements in agricultural production on Earth.

Operations

Operational Requirements

During its ascent, Tropi requires no resources. The dry seeds are contained in five seed cassettes located in the EMCS. Once in orbit, the seeds will be hydrated automatically. Through the experiment, video will be taken allowing the ground team to evaluate and study the progress of development of the plants. Ninety percent of the science return is based on video analysis. The crew will harvest the plants and store the specimens in MELFI. They are also required to change out the video tapes.

Operational Protocols

Seed cassettes containing dried *Arabidopsis thaliana* seeds will be initiated in the EMCS automatically. The EMCS will introduce water to the seeds to activate growth. Video cameras will record the growth and development of the plants. Once the plants are grown, the crewmembers will harvest the plants and place them in the cold storage in MELFI. The plants will be returned to the ground team for further study.

Close-up of *Arabidopsis* seedlings with seed cassette cover removed.

